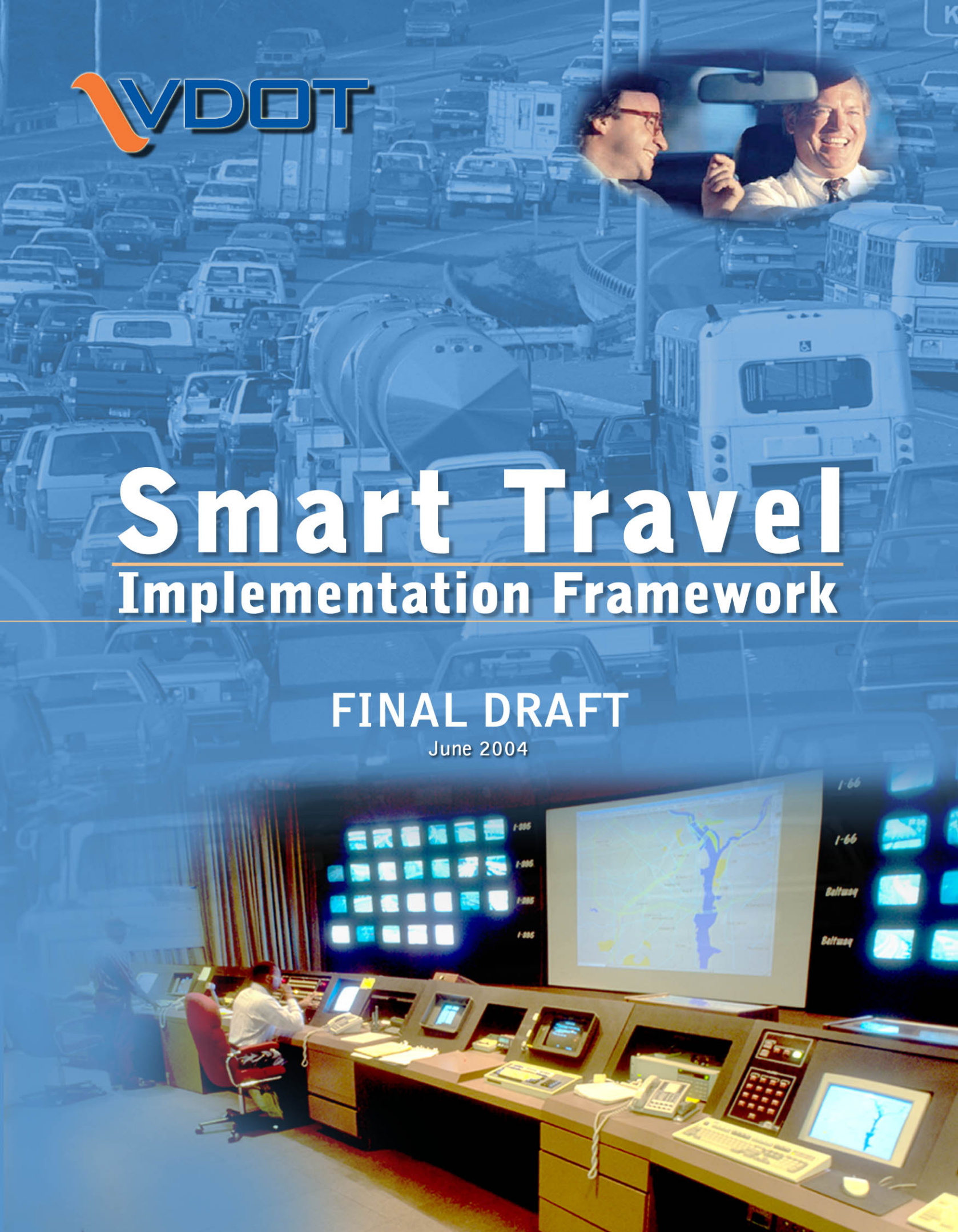

Smart Travel
Implementation Framework

FINAL DRAFT

June 2004

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SMART TRAVEL VISION

"Intelligent Transportation Systems [ITS] make travel 'smart' through computers, microprocessors, high speed wire and wireless communications, and a host of supporting sensory and electronic technology, as well as through automated, streamlined agency processes and procedures." – from the Smart Travel Strategic Plan

1 INTRODUCTION

The *Smart Travel Implementation Framework* is the pivotal document in the Virginia Department of Transportation's (VDOT) technology program, known as the Smart Travel Program. It is the lynchpin planning document connecting the broad program parameters of the *Smart Travel Strategic Plan* to the several, detailed *Concepts of Operation (COO)* and Regional ITS Architectures that govern the installation and use of Intelligent Transportation Systems (ITS) throughout the Commonwealth of Virginia.

The fundamental interdependence existing among the following three components of the Smart Travel Program is the essence of the planning, deployment, and operation of transportation technology. These components spell out the *what, who, where, how* and *when* of ITS in Virginia.

- The *Smart Travel Strategic Plan* defines the expansive opportunities associated with ITS through the establishment of Guiding Principles and the identification of Statewide Functions. Fulfillment of these functions is undertaken through the delivery of well-defined User Services. These User Services define *what* will be done through the adoption of transportation technology under the Smart Travel Program.

- The *Implementation Framework* adds dimension to the Smart Travel Program by assigning responsibilities for the delivery of User Services and defining the planning/budgeting process necessary to exercise these responsibilities. In this way, the Framework reveals *who* will provide User Services and *where*.

- *Concept of Operation* development is the planning exercise conducted at the district, corridor, or statewide level enumerating the projects, and associated deployment schedule, that make up the several ITS, that when taken in total, constitute User Services. The *COO* defines *how* a user service will be delivered and *when*.

The transportation technology addressed in the Smart Travel Program is another means by which VDOT strives to improve safety, enhance mobility, and increase customer satisfaction. Technology is the means the Smart Travel Program employs to achieve these goals. The heart of the Smart Travel Program is the outcomes relating to safety, mobility and satisfaction that transportation technology delivers, not the technology itself.

1.1 Purpose

The *Implementation Framework*, as noted above, is the link between the general statement of *what* will be done, as contained in the *Strategic Plan,* and the specific details of *how* it will be done, as defined in the *COO*. The linkage exists in the guidance the *Implementation Framework* offers to VDOT personnel on:

Roles and Responsibilities for implementation of the Smart Travel Program in Virginia. The Framework assigns roles and responsibilities on the basis of a particular function being statewide, corridor or district in orientation. Regardless of the functions orientation, the VDOT Districts are the foundation for delivering the Smart Travel Program. Specific roles and responsibilities of the Districts are described in detail in Chapter 2.

Planning and Programming of the Smart Travel Program at the project level. Chapter 3 of the document defines how transportation technology goes from concept to project. Special emphasis is given to how the Smart Travel Program planning process is being mainstreamed into the VDOT planning process to the benefit of both.

Project-level Implementation Issues and Barriers. While the *Implementation Framework* does not provide a list of particular projects for implementation, it does provide guidance, in Chapter 4, on typical issues and barriers faced during implementation.

1.2 Background

Smart Travel Guiding Principles and Goals

The intent of the VDOT Smart Travel Program is "… to improve the safety and efficiency of the transportation system in Virginia" utilizing technologies and technology-based services in accordance with the principles and goals, shown below, set forth in the *Smart Travel Strategic Plan:*

SMART TRAVEL GUIDING PRINCIPLES AND GOALS

Smart Travel Guiding Principles

- Focus on Practical Transportation Solutions
- Enhance Delivery of Public Agency Services
- Think Regionally and Act Locally
- Coordinate Intermodal Strategies
- Promote Private Investment
- Support ITS Research

Smart Travel Goals

- Improve Highway Safety
- Increase Mobility
- Enhance VDOT's Internal Productivity
- Improve Transportation Service and Quality of Life for the Citizens of Virginia
- Support Economic Development

VDOT ITS Architecture

In order to reach the Smart Travel goals, the *Strategic Plan* identifies ITS User Services to be implemented by VDOT. According to the National ITS Architecture, 'User Services document what ITS should do from the user's perspective. A broad range of users is considered, including the traveling public, as well as many different types of system operators.' VDOT has developed an ITS Architecture specific to Virginia Operations. This Architecture is based on the National ITS Architecture and have been customized for use in Virginia.[1] ITS Architecture provides a framework for planning, defining, and integrating ITS. Figure 1.1 shows the VDOT ITS Architecture hierarchal diagram.

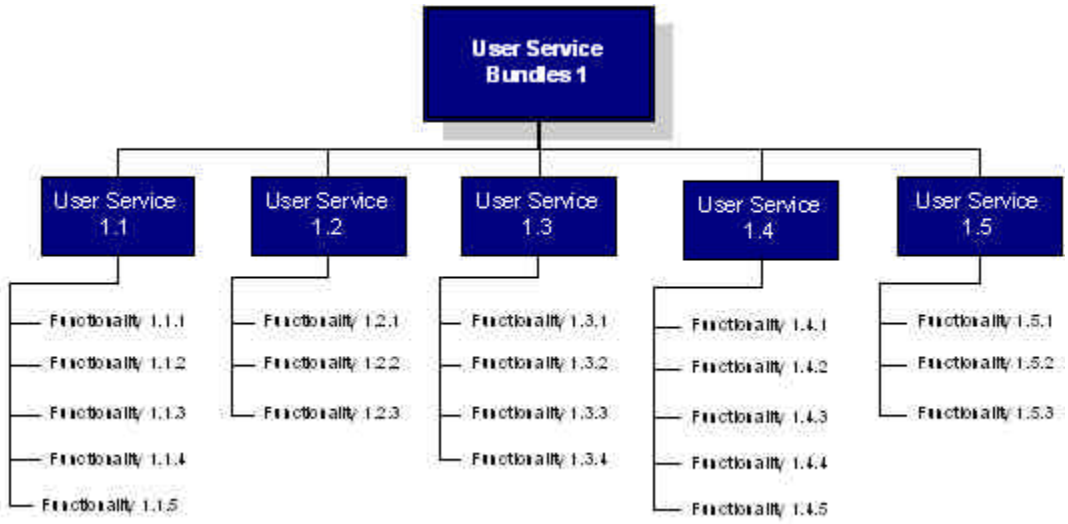

Figure 1-1 Sample VDOT ITS Architecture Diagram

User Service Bundles are logical groupings of User Services that provide a convenient way to discuss the range of requirements in a broad area. In the VDOT ITS Architecture, the User Services are grouped into six bundles: (1) System Management, (2) Electronic Payment Systems, (3) Emergency Management, (4) Personal Travel Services, (5) Commercial Vehicle Operations, and (6) Advanced Vehicle Safety Systems. These User Service Bundles and their corresponding User Services are described in more detail below:

1 System Management—ITS services in the system management bundle support VDOT's core mission in the areas of operations and management of traffic flow on VDOT facilities, maintenance operations, and the internal processes at VDOT.

[1] Appendix B maps the VDOT ITS Architecture to the National ITS Architecture. Some of the User Services bundles and User Services identified in the *Strategic Plan* are modified to reflect the changes in the National ITS Architecture Version 5.0, released after the development of the *Strategic Plan*.

1.1 Traffic Control and Management: Includes systems that manage traffic movement on streets and highways.

1.2 Incident Management: Helps public and private organizations identify the occurrence and nature of a highway incident, initiate the appropriate response, and clear the incident quickly.

1.3 Travel Demand Management: Supports policies and programs designed to mitigate the environmental and social impact of traffic and travel.

1.4 VDOT Operations Management: Automates VDOT business process including asset inventory and management, tracking maintenance activities, and providing customer service.

1.5 Archived Data Function: Automates statewide data collection, archiving and sharing for both VDOT internal and external customers.

1.6 Regulatory Functions: Promotes safer, more efficient enforcement of general traffic and vehicle regulations.

1.7 Public Transit Management: Automates transit operations, planning and management.

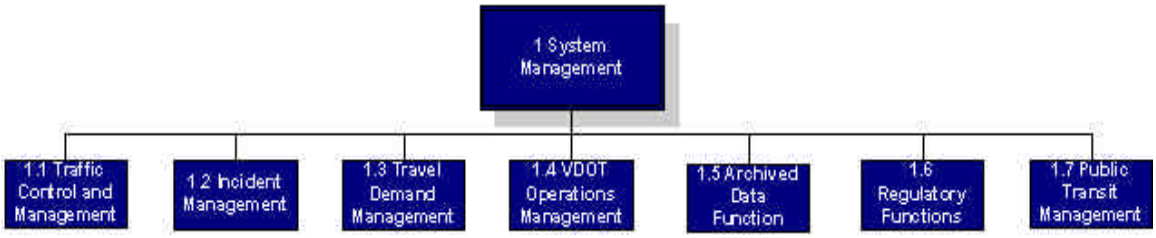

Figure 1-2 System Management Service Bundle

2 Electronic Payment Systems—ITS services in the electronic payment systems bundle allow travelers to pay for transportation services by electronic means.

2.1 Electronic Payment Services: Allows financial transactions to be accomplished electronically.

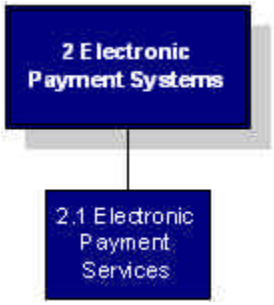

Figure 1-3 Electronic Payment System Bundle

3 Emergency Management—ITS services in the emergency management bundle support emergencies, disaster response and evacuation, security monitoring, and other security and public safety-oriented ITS applications.

3.1 Emergency Notification and Security: Allows motorists in emergency situations to contact aid directly from the vehicle.

3.2 Emergency Vehicle Management: Provides vehicle management of transportation services in the event of natural or manmade disaster.

3.3 Disaster Response and Evacuation: Provides for effective, coordinated management of the surface transportation system during all types of disasters including natural disasters (hurricanes, earthquakes, floods, severe winter storms, tsunamis, etc.), terrorist acts, and other catastrophic events (e.g., nuclear power plant disasters).

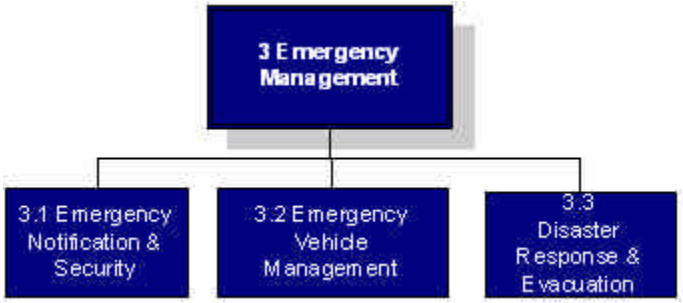

Figure 1-4 Emergency Management Bundle

4 Personal Travel Services—ITS services in the personal travel service bundle support travelers in all modes before and during their trip. It includes the provision of information and personal safety services that improve the total trip experience.

4.1 Pre-Trip Traveler Information: Provides information to help select the best transportation mode and route.

4.2 En-Route Traveler Information: Provides travelers with advisories and in-vehicle information for convenience and safety.

4.3 Route Guidance: Provides travelers with simple instructions to reach their destinations.

4.4 Traveler Services Information: Provides travelers with information on tourist attractions, parking, lodging, dining, fuel, etc.

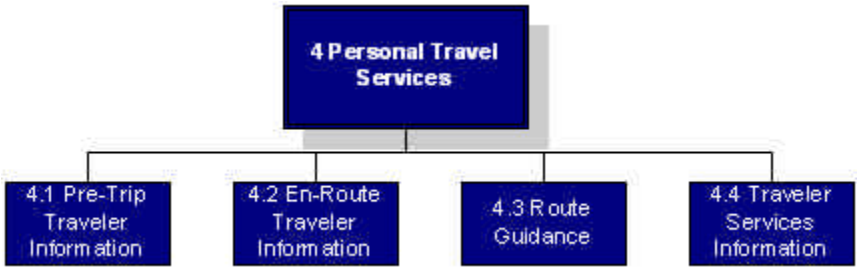

Figure 1-5 Personal Travel Services Bundle

5 Commercial Vehicle Operations—ITS services in the Commercial Vehicle Operations bundle support automation of paperwork and processes for both commercial carriers, Department of Motor Vehicles (DMV), and VDOT including credentialing, permitting, fee collection, weigh and safety inspections, and load restrictions. Most Commercial Vehicle Operations responsibility is now housed in the DMV including all administrative and regulatory functions.

5.1 Electronic Clearance: Automates domestic and international vehicle clearance. Typical systems include transponders on vehicles and readers at weigh stations and other clearance points, as well as automated weigh stations.

5.2 Intermodal Connections: Enhances Intermodal freight connections. Currently no systems are appropriate for VDOT needs.

5.3 Administrative Processes: Automates domestic and international paperwork for permits and licenses. Components include Internet access to automated forms, and other forms of communications and paperwork automation.

5.4 Automated Roadside Safety Inspection: Enables targeted safety inspection and improves safety record access. Components include databases and communications systems.

5.5 On-board Safety and Security Monitoring: Provides monitoring and warnings of safety and security problems.

5.6 Hazardous Materials Security and Incident Response: Focuses on providing information to emergency response agencies at the scene of an incident.

5.7 Freight Mobility: focuses on improving the efficiency of the movement of goods in an Intermodal system.

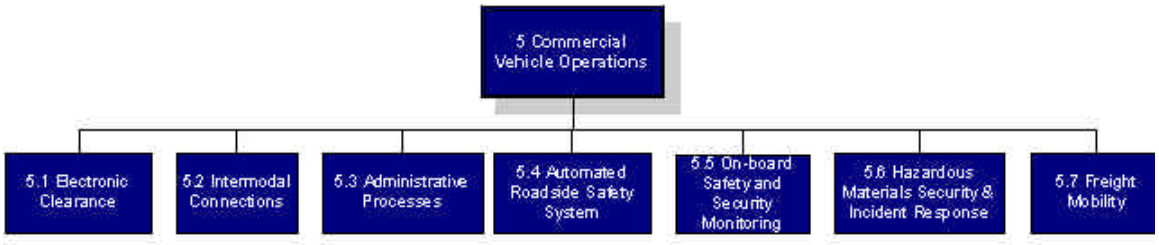

Figure 1-6 Commercial Vehicle Operations Bundle

6 Advanced Vehicle Safety Systems—ITS services in the Advanced Vehicle Safety System (AVSS) bundle support automation or enhancement of the driver's ability to safely navigate their route. AVSS can be found principally as equipment on vehicles, but may include supportive system elements in the roadway or roadside. The majority of AVSS is still in the research stage. VDOT's role is to support this research effort.

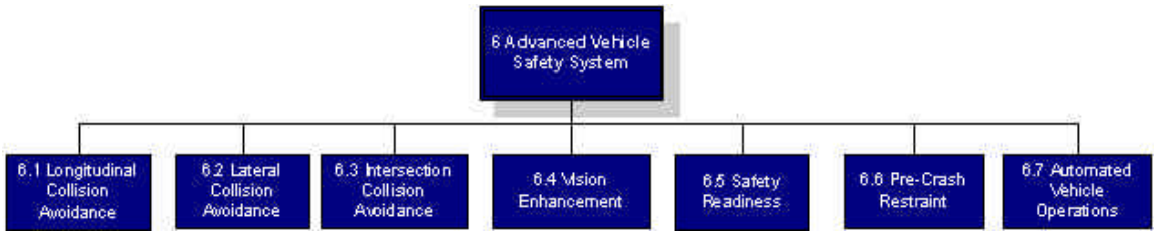

Figure 1-7 Advanced Vehicle Safety Systems Bundle

2 VDOT ITS DELIVERY RESPONSIBILITIES

This chapter defines the responsibilities for delivering User Services to the transportation users and defines the VDOT Districts' role in three areas: (1) Statewide Programs, (2) Region/Corridor, and (3) District Operations.

2.1 User Service Delivery Responsibilities

The *Strategic Plan* identified User Services that VDOT needs to perform in order to meet the mission of the Smart Travel Program but stopped short of assigning *who* is responsible for delivering these User Services. In order to efficiently and successfully deliver User Services, various VDOT stakeholders must understand their responsibilities. These responsibilities lie with three key stakeholders, which include: (1) Central Office, (2) Regional/Corridor Committees, and (3) VDOT Districts. A hierarchal depiction of these stakeholders is shown in the following figure.

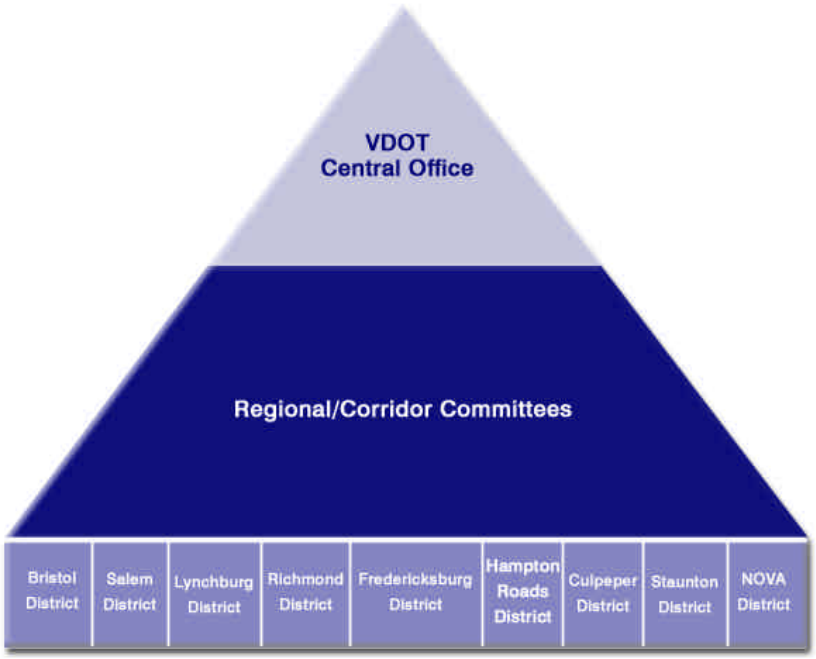

Figure 2-1 VDOT Smart Travel Implementation Stakeholders

It is not only important for each stakeholder to understand their own responsibilities in the Smart Travel Program, but also understand *who* is responsible for other User Services. Each stakeholder should know where to find guidance, policy, and coordination for the delivery of all User Services. Only by understanding each other's roles and responsibilities, can VDOT effectively deliver a User Service.

The following table depicts responsibilities for policy, guidance, and delivery of User Services in the Commonwealth of Virginia. This table sets the stage for future sections of this document.

Table 2-1 Smart Travel Program Service Delivery Responsibilities

	Statewide Policy and Coordination		Service Delivery Responsibility			
	Policy	**Coordination**	**Statewide**	**Regional/ Corridor**	**District/ Local**	**Other**
System Management						
Traffic Control and Management	✓	✓		✓	✓	
Incident Management	✓	✓		✓	✓	
Travel Demand Management	✓			✓	✓	✓[1]
VDOT Operations Management	✓	✓			✓	
Archived Data Function	✓	✓	✓			
Regulatory Functions	✓				✓	✓[2]
Public Transit Management				✓	✓	✓[3]
Electronic Payment Systems						
Electronic Payment Services	✓	✓	✓		✓	✓[4]
Emergency Management						
Emergency Notification & Personal Security	✓	✓				✓[5]
Emergency Vehicle Management					✓	✓[6]
Disaster Response and Evacuation	✓	✓		✓	✓	✓[7]
Personal Travel Services						
Pre-trip Traveler Information	✓		✓			✓[5]
En-Route Traveler Information	✓	✓	✓			✓[5]
Route Guidance						✓[5]
Traveler Services Information	✓	✓	✓			✓[5]
Commercial Vehicle Operations						
Commercial Vehicle Operations						✓[8]
Advanced Vehicle Safety Systems						
Intelligent Vehicle Initiatives – Research	✓	✓				✓[9]

Note: All the User Services under the User Service Bundles Commercial Vehicle Operations and Advanced Vehicle Safety Systems are combined into one User Service since VDOT's Mobility Management Division does not carry them.

Examples of 'Other' include:
1 Transit Agencies: Department of Rail and Public Transportation (DRPT), Local Government, and MPO
2 Law Enforcement Agencies: Virginia State Police
3 DRPT
4 Private Toll Roads (Dulles Greenway), Local Parking Lots, Toll Authorities, Regional Metropolitan Authority, Airports
5 Private Entities
6 Emergency Response Agencies: Virginia State Police
7 Virginia Department of Emergency Management (VDEM)
8 Department of Motor Vehicles (DMV)
9 US Department of Transportation (US DOT)

Table 2.1 identifies *who* and *where* the delivery responsibility lies for *what* (User Services). The following sections take the VDOT District User Service responsibilities a step further, identifying the Districts' roles and functions in three areas: (1) Statewide ITS Programs, (2) Region/Corridor ITS Programs, and (3) District Operations.

The material presented in these sections should be used as guidance to the VDOT Districts from Central Office on their roles and functions in the Smart Travel Program.

2.2 District Role in Statewide ITS Programs

VDOT is engaged in a series of Statewide ITS Programs. Some examples of Statewide Programs are summarized below:

Archived Data Management System—VDOT is in the process of developing a statewide mobility data store, which will act as an archived data repository for the entire state.

Critical Infrastructure Security—VDOT is implementing a statewide program to monitor bridges, tunnels, and other transportation assets vulnerable to manmade and natural disasters.

Statewide 511 Information Services—Virginia is planning a program to extend 511 traveler information services statewide.

Statewide Roadway Conditions Database—This statewide database, when completed, will act as a clearinghouse for real-time and archived roadway conditions. The database will be used to feed real-time roadway conditions data into the statewide 511 system.

Statewide Video Sharing—VDOT tentatively plans to make video imagery from its Smart Travel Centers available to the general public and other partners through non-exclusive partnerships with the private sector.

The relationship of the Statewide ITS Programs with the User Services is depicted in the following table:

Table 2-2 Statewide ITS Program User Services

	Archived Data Management System	Critical Infrastructure Security	Statewide 511 Information Services	Statewide Roadway Conditions Database	Statewide Video Sharing
System Management					
Traffic Control and Management	✓	✓	✓	✓	✓
Incident Management	✓	✓	✓	✓	✓
Travel Demand Management	✓		✓	✓	✓
VDOT Operations Management	✓	✓		✓	✓
Archived Data Function	✓			✓	✓
Regulatory Functions	✓	✓		✓	✓
Public Transit Management	✓		✓	✓	✓
Electronic Payment Services					
Electronic Payment Services					
Emergency Management					
Emergency Notification & Personal Security	✓		✓	✓	✓
Emergency Vehicle Management	✓		✓	✓	✓
Disaster Response and Evacuation	✓	✓	✓	✓	✓
Personal Travel Services					
Pre-Trip Traveler Information	✓		✓	✓	✓
En-Route Traveler Information	✓		✓	✓	
Route Guidance	✓			✓	✓
Traveler Services Information	✓		✓	✓	✓
Commercial Vehicle Operations					
Commercial Vehicle Operations	✓	✓	✓	✓	
Advanced Vehicle Safety Systems					
Intelligent Vehicle Initiatives – Research					

Though the Central Office does not operate ITS, it is responsible for overseeing the overall deployment of these Statewide ITS Programs.

The Districts role in the Statewide ITS Programs is to provide the Statewide ITS Programs with information/data so that the associated User Services are effectively delivered. The COO for each of the Statewide ITS Programs is the responsibility of Central Office with assistance and inputs from the Districts. The COO's for the Statewide ITS Programs will provide further information and direction to the Districts on their roles and responsibilities in the particular programs.

2.3 District Role in Region/Corridor

VDOT Districts play a critical role in the operations of the Region/Corridor. Interoperability among Districts is essential for these Regions/Corridors to operate as a seamless transportation system. In general, Districts role in the Region/Corridor programs is to consider coordination with one another and with other agencies to deliver the User Services.

The following table, originally identified in the *Strategic Plan*, gives Districts an idea of where (1) Multi-State, (2) Metropolitan Region, and (3) Key Corridor coordination may need to take place. For example, Bristol, Salem, and Staunton Districts need to coordinate with one another along the I-81Corridor. The Regional/Corridor policy committee formed for the I-81 Corridor will oversee the deliver of User Services within the corridor. The COO for each of the Region/Corridor programs developed by Region/Corridor policy committee will provide further information and direction to the Districts on their roles and responsibilities in these Region/Corridor programs.

Table 2-3 Region/Corridor District Responsibilities

District	Multi-State	Metropolitan Region	Key Corridors*											
			I-81	US 29	I-95	US 301	I-66	I-64	US 58	US 460	US 17	US 15	I-77	US 220 (I-73)
Bristol	✓	✓	✓						✓	✓			✓	
Salem	✓	✓	✓						✓	✓			✓	✓
Lynchburg	✓	✓		✓					✓	✓		✓		
Richmond	✓	✓			✓	✓		✓	✓	✓				
Hampton Roads	✓	✓			✓			✓	✓	✓	✓			
Fredericksburg	✓	✓			✓	✓					✓			
Culpeper				✓				✓			✓	✓		
Staunton	✓		✓				✓	✓			✓			✓
NOVA	✓	✓		✓	✓	✓	✓					✓		

* Key Corridors include the identified roadway and adjacent parallel and cross routes that impact the operations of the roadway.

2.4 District Operations

Districts are responsible for the day-to-day operations within their boundaries. In order to perform these operations, Districts should consider several functions. Functions are the next step down in the VDOT Architecture, stemming from User Services. Functions identify what types of operations need to be performed to fulfill a particular User Service. The COO's developed by the Districts will define the functions to be performed by a particular District.

This section presents the functions Districts may consider in fulfilling their District responsibilities. Functions are listed for User Services pertaining to District operations. (Note: Functions are not provided for User Services that do not pertain to District delivery of the User Service such as Commercial Vehicle Operations and Personal Travel Services).

The functions identified in this section are further defined in Appendix C.

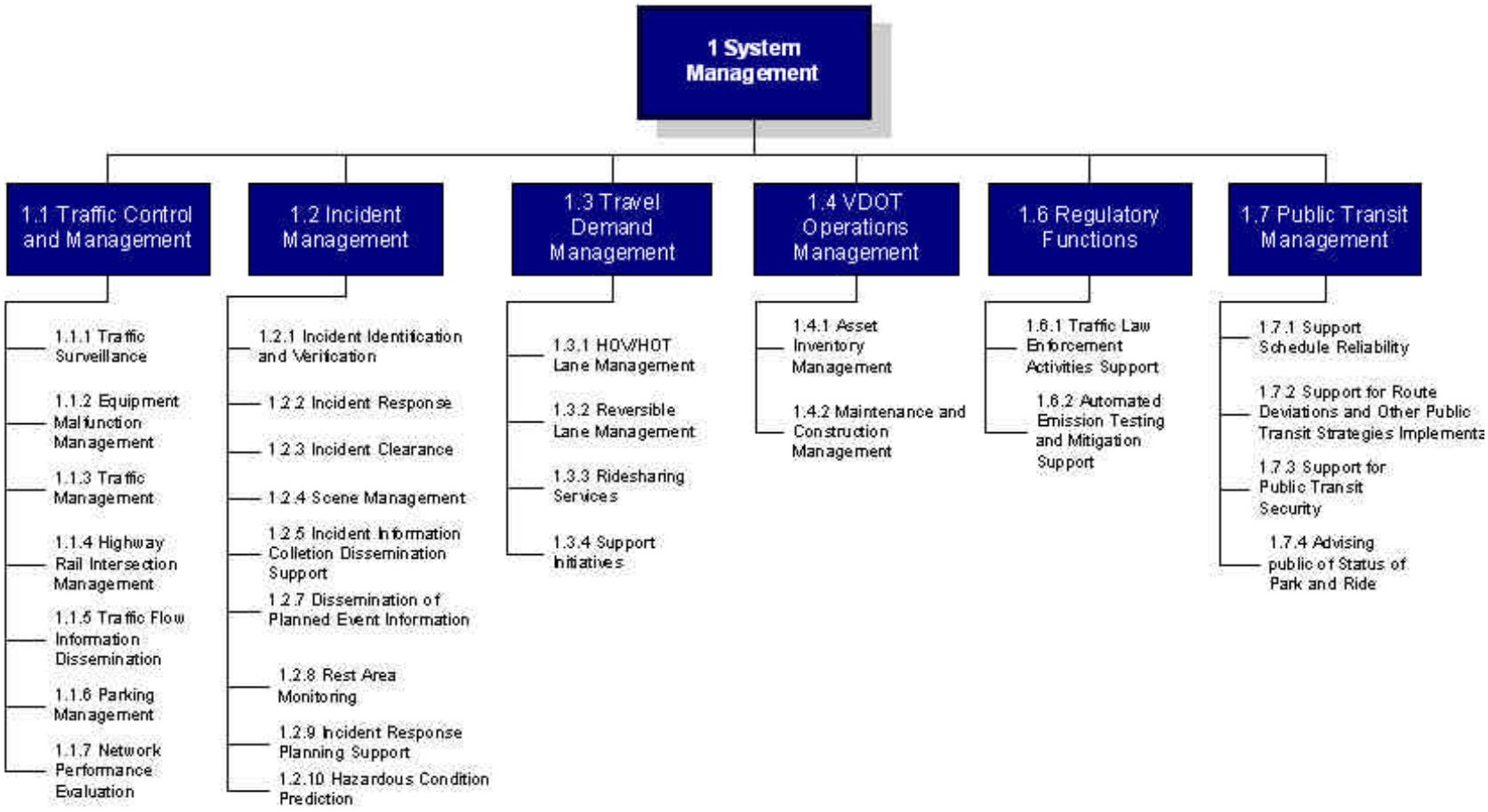

Figure 2-2 District System Management Architecture

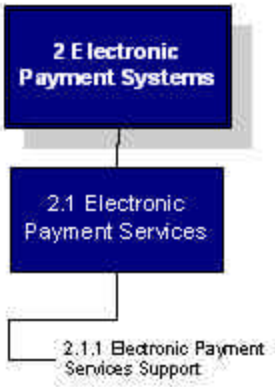

Figure 2-3 District Electronic Payment Services Architecture

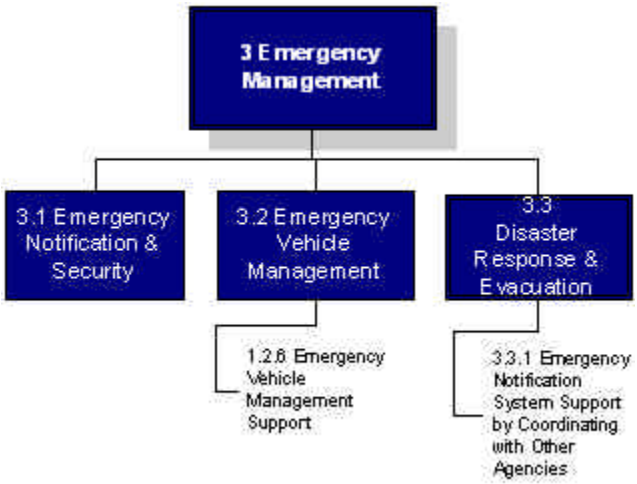

Figure 2-4 District Emergency Management Architecture

3 ITS PLANNING AND PROGRAMMING

The steps and processes for VDOT ITS planning and programming are addressed in the following sections of Chapter 3. The previous chapter discussed the roles and responsibilities of delivering User Services in the Commonwealth. This chapter focuses on mainstreaming the planning and programming of ITS projects to ensure those User Services can be delivered.

3.1 Smart Travel Planning Model

There are three key, inter-related documents that provide the planning for Smart Travel:

- *Smart Travel Strategic Plan*,
- *Smart Travel Implementation Framework*, and
- A set of COO's.

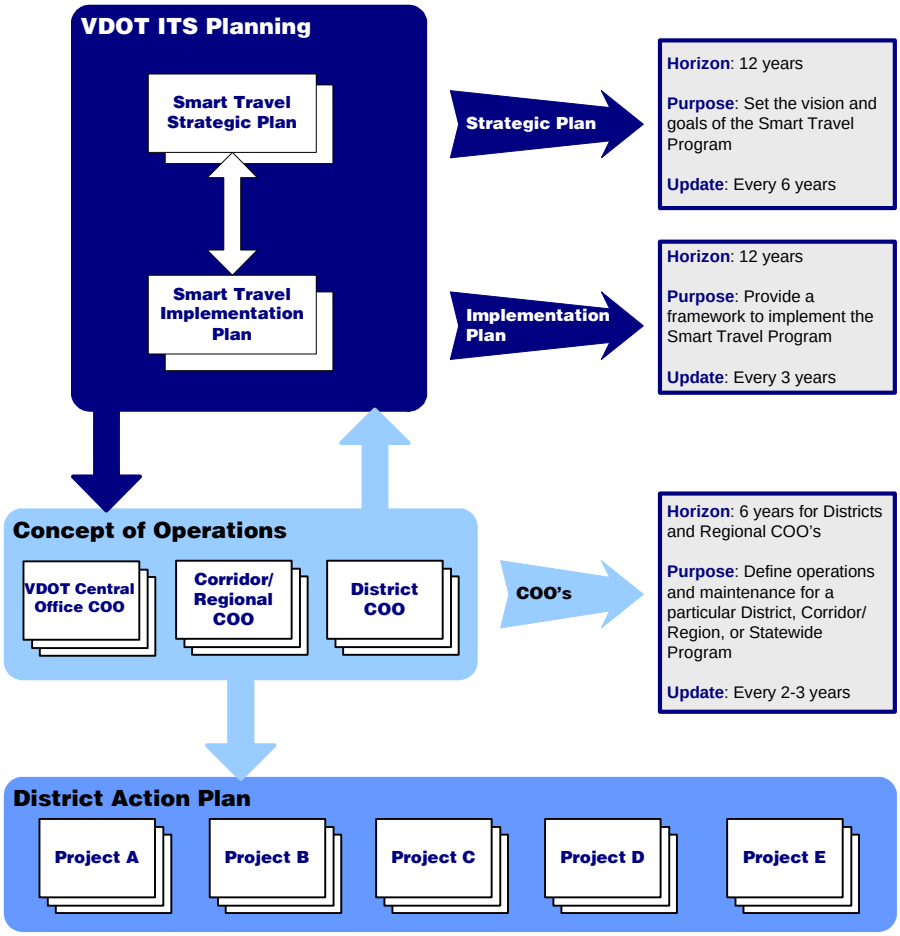

Figure 3-1 VDOT Smart Travel Planning Model

As depicted in Figure 3.1, the VDOT ITS Planning Model is based on a dynamically integrated 'Top Down/Bottom Up' approach, between VDOT Central Office and the Districts. The 'Top Down' approach consists of VDOT Central Office providing guidance to the Districts. This guidance is provided through two planning documents: (1) the *Strategic Plan* and (2) this *Implementation Framework*. A detailed description and purpose of each of these documents is provided in Chapter 1 of this document.

For the 'Bottom Up' planning, COO's are developed for each District, Corridor, and Statewide Programs. COO's use the guidance provided by Central Office to define operations and maintenance for a particular District, Region/Corridor, or Statewide ITS Program. In general, all COO's contain the following three elements: (1) a Needs Assessment, (2) a Strategic Plan, and (3) a Business Plan.

Needs Assessment

- Provides a vision statement,
- Identifies User Services offered/function performed, and
- Measures qualitatively the gap between current performance and optimal operations.

Strategic Plan

- Presents ITS solution capable of closing the identified gaps in the Needs Assessment, and
- Identifies key stakeholders and critical information flows in the Regional Architecture.

Business Plan

- Identifies and prioritizes specific ITS projects and activities,
- Provides engineering cost estimates for each project, and
- Distributes projects over known and/or projected funding.

The three elements above ensure that the COO's address the minimum requirements of the FHWA Final Rule (23 CFR Part 940 - Intelligent Transportation Systems Architecture and Standards, § 940.9 (d)). A matrix detailing how the COO's meet the minimum requirements is contained in Appendix D.

In addition to developing the COO's, Districts have several other ITS Planning responsibilities including strategic planning, updating the inventory, developing/updating communications plan, supporting Statewide ITS Programs, coordinating with local agencies, and providing outreach and training that would support the Smart Travel Program.

3.2 Smart Travel Programming

Through the COO's, a District action plan and resource needs are identified to construct, operate, and maintain the Smart Travel Program (at all levels – District, Region/Corridor, and Statewide). This is one means by which a project is identified to potentially be programmed.

Two other types of projects need to be considered when budgeting for ITS:

Considering facility management along with construction improvement—ITS solution can be a part of the larger, transportation project to alleviate a network deficiency. The projects with ITS solution to a particular transportation network can compete with other projects while applying the criteria to compile the prioritized list.

Considering ITS as interim solution between the duration of the prioritization of the project and its funding allocation—This interim solution can act as a temporary solution (until the planning and construction of the project) to alleviate the transportation deficiency until the project is completed. Even after the completion of the project, ITS solution can add to improve the efficiency of the project.

These two types of ITS projects become known through the VDOT highway planning and programming process, undertaken on yearly basis. Figure 3.2 provides a summary of the VDOT highway planning and programming process. It also depicts how all three types of projects are fed into and out of the ITS budget process. District ITS budgeting is also completed yearly.

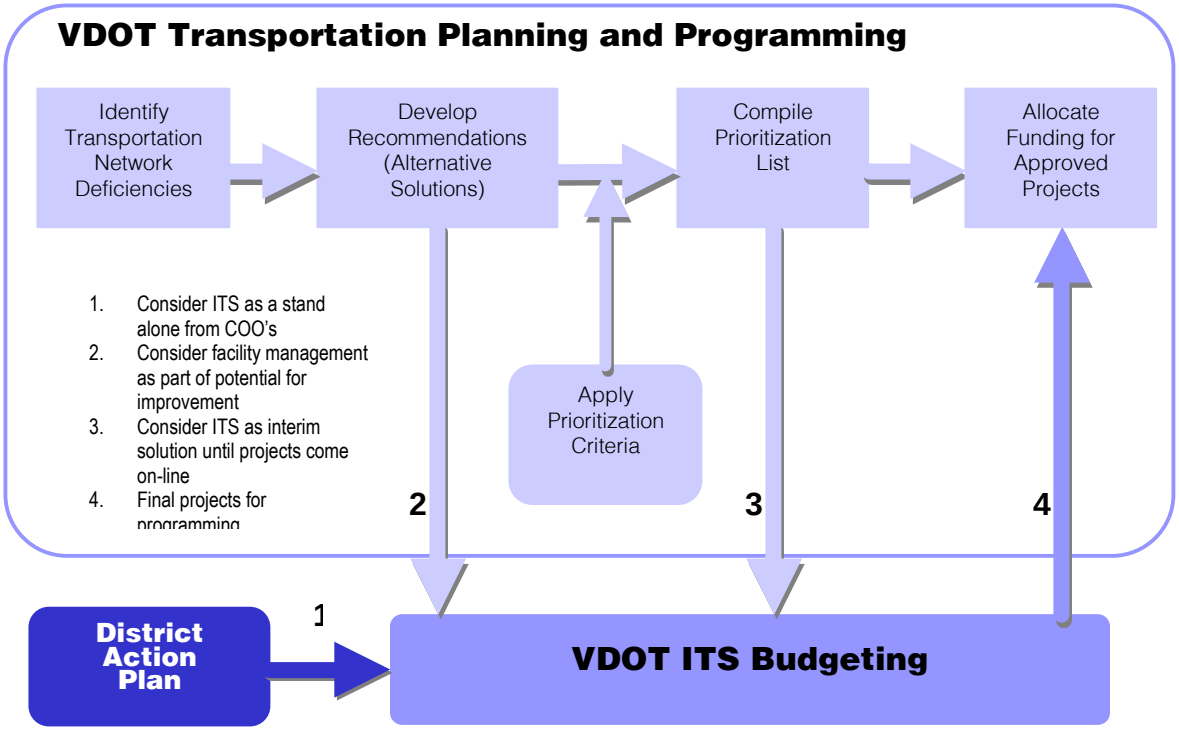

Figure 3-2 VDOT ITS Programming

4 IMPLEMENTATION ISSUES

In order to implement programmed ITS projects, there is little doubt that several typical institutional and technical issues will be faced. The purpose of Chapter 4 is to document typical implementation issues, overview a proven process to resolve them, and identify high-level implementation responsibilities. Typical implementation issues include:

Communications—Communication issues may arise between stakeholders as well as between software systems. Interoperable communication between all parties, systems and stakeholders, must exist to successfully deliver a User Service.

Configuration Management—Changes with software are inevitable. Configuration Management includes a set of activities designed to control change by (1) identifying the work products that are likely to change, (2) establishing relationships among them, (3) defining mechanisms for managing different versions of these work products, (4) controlling changes that are imposed, and (5) auditing and reporting on the changes that are made.

In-house vs. Contracted Services for Systems—Systems may be housed within VDOT facilities or contracted out to another agency. Pros and cons exist for each alternative. In-house systems are owned and controlled by VDOT, but require maintenance, operation and additional personnel to run the systems. Contracted systems are controlled by outside agencies, but do not always allow the flexibility of in-house systems.

Maintenance vs. Capital Investment—Maintaining deteriorating/older ITS systems and devices can become expensive over time. Often purchasing new equipment rather than maintaining the old proves to be more cost effective in the long run. A life cycle approach to procurement should be taken.

System Disaster Recovery—ITS systems may shutdown during naturally, manmade, or other disasters. A plan for recovery from these disasters should be in-place so that these systems become operational in a timely manner.

Technological Obsolescence—Many times significant technological advances render today's cutting edge solution obsolete by the time a project is implemented.

System Evaluation Process—Processes need to be in place to evaluate the performance of ITS systems. Criteria, such as Measures of Performance, must be identified so that these systems can be evaluated accurately and consistently.

Procurement Options—The successful acquisition of ITS has proven to be a challenge for many public transportation agencies. A *Guide to Contracting Intelligent Transportation System Projects* (*Guide*) is currently being developed through the National Cooperative Highway Research Program (NCHRP) to serve as a resource when evaluating ITS procurement options. Criteria for categorizing ITS

projects as a basis for selecting a procurement option will be outlined in the *Guide*, including:

- System Complexity
- Level of New Development
- Scope & Breadth of Technologies Involved
- Interfaces with Other Systems
- Technology Evolution
- Requirements Fluidity

The *Guide* is due to be completed in the Fall of 2005.

4.1 Systems Engineering Process

While solutions to the above issues are not boilerplate, following a proven process will ensure that all issues are identified and resolved before final deliver and acceptance of a system. The Systems Engineering process integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation and maintenance. The purpose of Systems Engineering is to (1) reduce risk, (2) control cost and schedule, and (3) satisfy users' needs. The Systems Engineering Life Cycle is depicted below. Applying this process to ITS projects does not ensure that implementation issues will not arise during a project; rather it provides a process for dealing with issues and helps to alleviate their impact on the project.

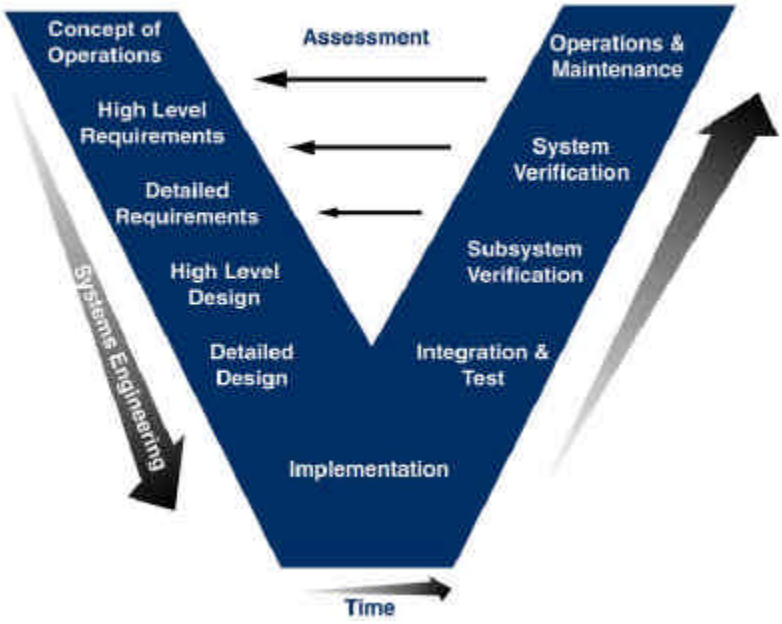

Figure 4-1 Systems Engineering Process

Since the process is iterative, implementation can be accomplished in small, manageable pieces. Approaching projects in this manner can alleviate issues, such as technological obsolescence, and allow a more constant measurement of performance.

4.2 ITS Standards

This framework emphasizes the need for transparent data and information exchange between those jurisdictions and agencies operating and managing the transportation system and, for some types of data and information, exchange with non-surface transportation agencies such as the military. Often, such transparent and automated exchanges are dependent on equipment that can "talk" to each other. In turn, the ability to talk may rest on common standards and protocols.

To accrue the benefits noted above, systems and the underlying equipment must be designed according to standards that enable interoperability. ITS standards are industry-consensus standards that define how system components operate within a consistent framework. The USDOT standards web page (http://www.standards.its.dot.gov) should be referenced for further detail on ITS standards.

4.3 District Action Plan Implementation Responsibilities

Since there is not a one-stop solution for any implementation issue, clearly defining the responsibilities of various stakeholders during the implementation of a project will help VDOT define strategies to resolve issues. Each stakeholder should understand *who* is responsible for the following tasks: (1) planning, (2) developing, (3) implementing, (4) operating, (5) maintaining, and (6) budgeting an ITS project. By understanding *who* is responsible for conducting each of these tasks, Central Office and the Districts can understand where to look for guidance or help when/if implementation issues arise. The following table depicts VDOT project implementation responsibilities for User Services.

Table 4-1 District Action Plan Implementation Responsibilities

	Plan	Develop	Implement	Operate	Maintain	Budget
System Management						
Traffic Control and Management	District	District	District	District	District	District
Incident Management	District	District	District	District	District	District
Travel Demand Management	District	District	District	Other	Other	Central Office
VDOT Operations Management	District	District	District	District	District	District
Archived Data Function	Central Office/District	Central Office/District	Central Office/District	Central Office/District	Central Office/District	Central Office
Regulatory Functions	Central Office	Central Office	Central Office	District	District	Other
Public Transit Management	Other	Other	Other	Other	Other	Other
Electronic Payment Systems						
Electronic Payment Services	Central Office	Central Office	Central Office	Central Office	Central Office	Central Office
Emergency Management						
Emergency Notification and Personal Security	District	District	District	District	District	Central Office/ District
Emergency Vehicle Management	Other	Other	Other	Other	Other	Other
Disaster Response and Evacuation	Central Office/ District/Other	Central Office/ District/Other	District/Other	District/Other	District/Other	Central Office/ District/Other
Personal Travel Services						
Pre-trip Traveler Information	Central Office	Central Office/ Other	District/Other	District/Other	District/Other	Central Office/ Other
En-Route Traveler Information	Central Office	Central Office/ Other	District/Other	District/Other	District/Other	Central Office/ Other
Route Guidance	Other	Other	Other	Other	Other	Other
Traveler Services Information	Central Office/ District	Central Office/ Other	Other Other	Other Other	Other Other	Central Office/ Other
Commercial Vehicle Operations						
Commercial Vehicle Operations	Other	Other	Other	Other	Other	Other
Advanced Vehicle Safety Systems						
Intelligent Vehicle Initiatives – Research	Other	Other	Other	Other	Other	Other

5 SUMMARY

Linking the guiding principles, goals, vision, and Architecture of the *Smart Travel Strategic Plan* and the needs and priorities for operations and maintenance outlined in VDOT Concept of Operations, the *Smart Travel Implementation Framework* reveals w*ho* will provide User Services *where.*

VDOT Districts, VDOT Regional/Corridor committees, and VDOT Central Office will deliver the VDOT Smart Travel program in cooperation with other agencies and private sector investment. All parties play a critical role in reaching the vision for VDOT Smart Travel.

The VDOT Districts are the operators of ITS in Virginia and therefore, provide the foundation for the Smart Travel program. The Districts provide the necessary data and support infrastructure for *statewide programs*, coordinate on inter-District R*egional and Corridor operations*, and operate ITS within their *District* borders.

Three key, inter-related documents provide the planning for VDOT Smart Travel:

- *Smart Travel Strategic Plan*
- *Smart Travel Implementation Framework*
- A set of Concept of Operations

The result of these documents is an action plan to implement ITS in Virginia. In addition to the action plans, VDOT Districts must consider facility management as a component of a highway project and ITS as an interim solution when budgeting and prioritizing ITS projects for funding and implementation. Ultimately, successful deliver of Smart Travel is dependent on project delivery. Following the FHWA Systems Engineering process aids successful implementation, avoiding the pitfalls and navigating through the issues typical of ITS projects.

This document is a framework to take the VDOT Smart Travel vision and make it reality.

APPENDIX A: METHODOLOGY

The methodology for development of this document included a well-structured step-by-step approach.

Smart Travel Implementation Framework Development Methodology

Step 1: *Formulate Steering Committee*

Step 2: *Review Existing Planning Documents*

Step 3: *Identify VDOT User Services*

Step 4: *Identify VDOT User Services Delivery Responsibilities*

Step 5: *Develop Planning and Programming Strategies*

Step 6: *Identify Implementation Issues*

A Steering Committee was formulated to oversee the development of the document. The Steering Committee included personnel from the Mobility Management Division, VDOT District Offices (specifically, ITS Coordinating Committee members), the Federal Highway Administration Virginia Division Office, and other VDOT Central Office departments. The Steering Committee guided the development process. Inputs for each of the steps were collected and validated through a series of Steering Committee meetings:

- Steering Committee Meeting #1 – Charlottesville, VA (October 29, 03)
- Steering Committee Meeting #2 – Richmond, VA (November 14, 03)
- Steering Committee Meeting #3 – Fredericksburg, VA (December 02, 03)
- Steering Committee Meeting #4 – Richmond, VA (January 22, 04)
- VDOT Mobility Management Division Meeting #1 – Richmond, VA (March 03, 04)
- VDOT Mobility Management Division Meeting #2 – Richmond, VA (April 05, 04)
- Steering Committee Meeting #5 – Charlottesville, VA (May 27, 04)

To ensure consistency with and build upon previous planning efforts, existing VDOT planning documents were reviewed. Review and analysis of these documents provided the introduction and background described in Chapter 1.

Based on input from the Steering Committee, a User Service delivery responsibility table identifying *who* is primarily responsible for delivering the User Services was developed. The User Service delivery responsibility table helped to define the roles and responsibilities of various key stakeholders within the Smart Travel Program as related in Chapter 2.

Defining the planning and programming processes for ITS was completed through a combination of Steering Committee meetings, meetings with Mobility Management Division staff, and a meeting with VDOT Central Office planners. These meetings and follow-up analysis led to the development of the processes identified in Chapter 3.

Finally, issues and barriers surrounding the implementation of ITS projects were identified through brainstorming with the Steering Committee. Strategies, consistent with FHWA guidance were also discussed at these meetings. These Steering Committee meetings provided the basis for Chapter 4 of the *Implementation Framework*.

APPENDIX B: ARCHITECTURE MAPPING

Appendix B relates the VDOT ITS Architecture (User Service Bundles, User Services, and Functions) presented in this document to the National ITS Architecture. Additional information on National TS Architecture can be obtained from the following website (http://itsarch.iteris.com/itsarch).

VDOT Architecture	Corresponding to:
1 System Management	1 Travel and Traffic Management 2 Public Transportation Management 7 Information Management 8 Maintenance and Construction Management
1.1 Traffic Management	1.6 Traffic Control 1.10 Highway-Rail Intersection
1.1.1 Traffic Surveillance	User Service Requirements: 1.6.2, 1.8.1.5, 1.8.2.3
1.1.2 Equipment Malfunction Management	User Service Requirement: 1.6.5
1.1.3 Traffic Management	User Service Requirements: 1.6.3, 1.8.3.1
1.1.4 Highway-Rail Intersection Management	User Service Requirement: 1.10
1.1.5 Traffic Flow Information Dissemination	User Service Requirements: 1.6.4, 1.8.1.5, 1.8.2.3
1.1.6 Parking Management	User Service Requirements: 1.6.2.1.6
1.1.7 Network Performance Evaluation	User Service Requirements: 1.1, 1.2.6, 1.3.2, 1.4
1.2 Incident Management	1.7 Incident Management
1.2.1 Incident Identification and Verification	User Service Requirements: 1.7.1, 1.7.2, 4.5.2
1.2.2 Incident Response	User Service Requirements: 1.7.2, 4.5.2
1.2.3 Incident Clearance	User Service Requirement: 1.7.3
1.2.4 Scene Management	User Service Requirement: 1.7.5
1.2.5 Incident Information Dissemination Support	User Service Requirements: 1.7.3.4
1.2.7 Dissemination of Planned Event Information	User Service Requirement: 1.7.6
1.2.8 Rest Area Monitoring	User Service Requirement: 1.7.7
1.2.9 Incident Response Planning Support	User Service Requirements: 1.7.2.1, 1.7.2.2, 1.7.2.4
1.2.10 Hazardous Condition Prediction	User Service Requirement 4.5.2
1.3 Travel Demand Management	1.4 Ride Matching and Reservation 1.8 Travel Demand Management
1.3.1 HOV/HOT Lane Management	User Service Requirements: 1.8.1.2, 1.8.1.3, 1.8.2.1, 1.8.2.4, 1.8.2.7, 1.8.2.8
1.3.2 Ridesharing Services	User Service Requirement: 1.8.1.6
1.3.3 Travel Demand Management Services	
1.4 VDOT Operations Management	8.1 Maintenance and Construction Operations
1.4.1 Asset Inventory Management	User Service Requirements: 7.1.1, 7.1.2, 7.1.3, 7.1.4
1.4.2 Maintenance and Construction Management	N/A
1.5 Archived Data Function	7.1 Archived Data Function

VDOT Architecture	Corresponding to:
1.6 Regulatory Functions	1.9 Emissions Testing and Mitigation
1.6.1 Traffic Law Enforcement Activities	User Service Requirement: 7.2.2
1.6.2 Automated Emission Testing and Mitigation Support	User Service Requirement: 7.2.1
1.7 Public Transit Management	2.1 Public Transportation Management 2.3 Personalized Public Transit 2.4 Public Travel Security
1.7.1 Support Schedule Reliability	User Service Requirements: 2.1.1.2.2, 2.1.1.2.3
1.7.2 Support for Route Deviations and Other Public Transit Strategies Implementation	User Service Requirements: 2.2.3.1.1, 2.2.3.1.2
1.7.3 Support for Public Transit Security	User Service Requirements: 2.4.1.1, 2.4.1.2, 2.4.2.2, 2.4.4.4, 2.4.4.5
1.7.4 Advising Public of Status of Park and Ride	User Service Requirement: 2.1.5
2 Electronic Payment Systems	3 Electronic Payment
2.1 Electronic Payment Services	3.1 Electronic Payment Services
2.1.1 Electronic Payment Services Support	User Service Requirements: 7.1.1, 7.1.2
3 Emergency Management	5 Emergency Management
3.1 Emergency Notification and Security	5.1 Emergency Notification and Personal Security
3.2 Emergency Vehicle Management	5.2 Emergency Vehicle Management
1.2.6 Emergency Vehicle Management Support	User Service Requirements: 5.2.2, 5.2.3
3.3 Disaster Response and Evacuation	5.3 Disaster Response and Evacuation
3.3.1 Emergency Notification System Support by Coordinating with Other Agencies	User Service Requirement: 5.1.3
4 Personal Travel Services	1 Travel and Traffic Management
4.1 Pre-Trip Traveler Information	1.1 Pre-Trip Travel Information
4.2 En-Route Traveler Information	1.2 En-Route Driver Information 2.2 En-Route Transit Information
4.3 Route Guidance	1.3 Route Guidance
4.4 Traveler Services Information	1.5 Traveler Services Information
5 Commercial Vehicle Operations	4 Commercial Vehicle Operations
5.1 Electronic Clearance	4.1 Commercial Vehicle Electronic Clearance
5.2 Intermodal Connections	N/A
5.3 Administrative Processes	4.4 Commercial Vehicle Administrative Processes
5.4 Automated Roadside Safety Inspection	4.2 Automated Roadside Safety Inspection

VDOT Architecture	Corresponding to:
5.5 On-board Safety and Security Monitoring	4.3 On-board Safety and Security Monitoring
5.6 Hazardous Materials Security and Incident Response	4.5 Hazardous Material Security and Incident Response
5.7 Freight Mobility	4.6 Freight Mobility
6 Advanced Vehicle Safety Systems	6 Advanced Vehicle Safety Systems
6.1 Intelligent Vehicle Initiative – Research	6.1 Longitudinal Collision Avoidance 6.2 Lateral Collision Avoidance 6.3 Intersection Collision Avoidance 6.4 Vision Enhancement for Crash Avoidance 6.5 Safety Readiness 6.6 Pre-Crash Restraint Deployment 6.7 Automated Vehicle Operation

APPENDIX C: VDOT DISTRICT FUNCTIONS

1 System Management

1.1 Traffic Control and Management

1.1.1 Traffic Surveillance—includes continuously monitoring and detecting real-time vehicle flow and roadway conditions on freeways and streets. Flow and roadway condition information collected may include, but is not limited to:

- Current traffic speeds and volume;
- Recurring weekly/seasonal congestion levels;
- Weather hazards such as fog and ice;
- Detection of over-height vehicles at height restricted facilities;
- Detection of vehicles in parking facilities; and
- Detection of high occupancy vehicles (HOV).

Traffic surveillance can also provide the capability to acquire detailed traffic measurements at specific locations. Data will be combined and processed using a data process function, and the resulting information should be used to provide continuous knowledge of existing conditions, including expected traffic flow impact of incidents/emergencies.

1.1.2 Equipment Malfunction Management—includes identifying field equipment failure and establishing backup plans to maintain safe operations. Equipment malfunction management can include:

- Detection of field device malfunction with specific location/identification;
- Detection of controller equipment failure with specific location/identification;
- Detection of power failures;
- Communication of alarm regarding any equipment malfunction; and
- Identification of type of fault causing equipment malfunction.

1.1.3 Traffic Management—includes using real-time condition information gathered by the *Roadway Surveillance* function to devise, test, enact, and monitor the results of changes in tactical operations. Traffic management will employ control strategies that seek to maximize the safety and efficiency of traffic movement on surface streets and on freeways. The purpose of this function is to minimize delay times, energy use, and air quality impacts due to traffic while maximizing the safety of pedestrians, bicycles, and vehicles. Traffic management should be responsive to current and expected demand to provide the capability to determine the strategy for the dissipation of traffic congestion based on current demand. Examples of equipment used to manage traffic include:

- Traffic signals,
- Reversible and HOV/HOT lane control (e.g., access gates and dynamic HOV restriction signs),
- Dynamic message signs (DMS), and
- Highway advisory radio (HAR).

1.1.4 Highway-Rail Intersection Management—includes monitoring highway-rail crossings to ensure the safety of motorists, and coordinating highway and rail management operations. Highway-Rail Intersection Management will control intersection barriers and provide closure information to approaching highway vehicles (e.g., via DMS) at highway-rail intersections with active rail railroad warning systems. VDOT Districts can provide the capability for automatic collision notification to highway vehicles, as well as train operators and management. Districts may also provide an interface between systems performing the *Traffic Management* function with those freight and passenger rail management systems, in order to exchange information to best coordinate rail and highway traffic, demand, and schedules.

1.1.5 Traffic Flow Information Dissemination—includes alerting other agencies and the public of current flow conditions on the roadway network. Traffic flow information will be exchanged between VDOT Districts and other agencies through pre-arranged data transfer formats/protocol, which will define how the data will be packaged and sent. Agencies that may receive traffic flow information include:

- Other VDOT offices/systems for multi-District coordination purposes;
- Public safety agencies for routing purposes;
- Transit agencies for scheduling and routing purposes; and
- Private information service providers (ISPs) for managing and disseminating tailored traveler information (e.g., 511 service providers).

VDOT Districts can also disseminate current traffic flow information directly to the public through various means, including dynamic message signs (DMS), and highway advisory radios (HAR).

1.1.6 Parking Management—includes support of other agency strategies to encourage the use of parking facilities as a tool for increasing vehicle occupancy. This function can include:

- Informing motorists when parking facilities are open/full;
- Managing traffic traveling to/from parking facilities at large events; and
- Encouraging traffic diversion from congested routes to public transportation multimodal facilities by disseminating tailored information to approaching motorists.

1.1.7 Network Performance Evaluation—includes the capability to predict travel demand patterns to support traffic flow optimization, demand management, and incident management.

1.2 Incident Management

1.2.1 Incident Identification and Verification—includes identification and verification of construction activities, maintenance activities, vehicle incidents, roadway weather conditions, special events, and other non-recurring events. VDOT Districts will typically receive incident identification and verification information primarily from the Virginia State Police, but supplemental information may be collected through the following sources:

- Traffic flow sensors (provided by *Roadway Surveillance* function),
- Other public safety sources,
- Media sources, and
- Other transportation providers.

1.2.2 Incident Response—includes coordination with other agencies to determine the magnitude of an incident, and managing the most appropriate dispatch of resources in response. Agencies VDOT Districts may communicate with include:

- Other VDOT, state, and/or local transportation officials,
- State and/or local public safety (police, fire, emergency medical services) departments,
- Highway patrols,
- Environmental protection agencies,
- HAZMAT teams, and
- Towing/wrecker/"courtesy" services.

Coordination with other agencies may be used for facilitating the appropriate:

- Scheduling of construction, maintenance, and utility work activities,
- Dispatch of VDOT and other agency emergency and service response vehicles to an incident,
- Dissemination of incident related information to travelers and potential travelers, and
- Control of traffic signals and other traffic control to reduce the traffic flow impact of an incident.

1.2.3 Incident Clearance—includes assisting other agencies in safely clearing all incident obstructions from the roadway vehicle paths. The VDOT District role is to coordinate the selection/determination of the procedures needed for returning the roadway to normal operating conditions, and to provide those procedures to agencies responding to the incident.

1.2.4 Scene Management—includes managing the flow of traffic to secure and maintain the safety of motorists and incident response personnel. VDOT Districts will provide the capability to manage traffic at the incident location and its vicinity through the use of various types of field equipment, including:

- Portable dynamic message signs (DMS) and highway advisory radio (HAR)
- Vehicle-mounted directional arrows, flares, cones, etc.

1.2.5 Incident Information Collection and Dissemination Support—includes tracking and transferring data/information regarding incident management operations to various agencies, including those that disseminate information to the public. Incident information may be exchanged between VDOT Districts and other agencies through pre-arranged data transfer formats/protocol, which will define how the data will be packaged and sent. Agencies that may receive incident information include:

- Other VDOT offices/systems for multi-District coordination purposes,
- Public safety agencies for dispatch and routing purposes,
- Local or regional businesses,
- Transit agencies for routing purposes,
- Media sources, and
- Private information service providers (ISPs) for managing and disseminating incident information (e.g., 511 service providers).

VDOT Districts can also disseminate incident information directly to the public through various means, including fixed dynamic message signs (DMS), and highway advisory radio (HAR).

1.2.7 Dissemination of Planned Event Information—includes disseminating information on scheduling of roadway activities to organizations, which disseminate information to the public. Information will be collected and managed by the *Maintenance and Construction Management* function, and will include current information about:

- Planned special events,
- Construction activities, and
- Maintenance activities.

1.2.8 Rest Area Monitoring—includes implementation of tools that will supplement Virginia State Police safety surveillance of rest areas by identifying events indicative of criminal activity and/or motorist distress. Systems that can be implemented by VDOT Districts include distress signals and CCTV cameras.

1.2.9 Incident Response Planning Support—includes participation with other agencies and local governments to devise incident management plans for various scenarios. VDOT Districts may propose and facilitate the appropriate:

- Scheduling of construction, maintenance, and utility work activities to minimize impacts on traffic;
- Dispatch of emergency response vehicles to an incident; and

- Procedures for dissemination of incident related information among agencies, and to travelers and potential travelers.

1.2.10 Hazardous Condition Prediction—includes processing collected data/information about current roadway conditions to predict the probability of hazardous traveling conditions along specific segments of roadway. Information will be provided by the *Roadway Surveillance* and *Incident Identification and Verification* functions. The function will include algorithms that may use current information on the following:

- Congestion levels,
- Inclement weather and road surface conditions,
- Construction activity,
- Public safety personnel activity,
- Incidents and disabled vehicles, and
- Traffic due to major events.

Hazardous traveling conditions may then be provided to VDOT District operations personnel for appropriate action, which may include operations such as preemptive resource dispatching and DMS/HAR motorist warning messages.

1.3 Travel Demand Management

1.3.1 HOV/HOT Lane Management—includes support of other agency strategies to encourage the use of HOV/HOT lanes as a tool for increasing vehicle occupancy. The function shall provide the capability to generate guidance to operations personnel for optimal pricing and occupancy requirements.

1.3.2 Ridesharing Services—includes support of other agency processes enabling travelers to share vehicles when destinations/routes and time of travel match. There are four processes that should be supported: (1) screen rider requests (2) match rider and provider (3) report ride match results to requestor and (4) confirm traveler rideshare request.

1.3.3 Travel Demand Management Services—includes support of other agency services reducing the traveler demand during peak and off-peak periods. Examples of travel demand management service support include:

- Encouraging workers to telecommute, and
- Encouraging employers to allow flexible working hours (flex hours).

1.4 VDOT Operations Management

1.4.1 Asset Inventory Management—includes developing inventory and managing pavement, bridges, highway infrastructure, and transportation-related assets. The types of VDOT District assets that are inventoried and managed will vary, and may include vehicles and equipment, as well as "soft" assets such as human resources

and software. Asset management is performed to monitor the condition, performance, and availability of the infrastructure and evaluate and prioritize alternative reconstruction, rehabilitation, and maintenance strategies.

1.4.2 Maintenance and Construction Management—includes monitoring and managing roadway infrastructure construction and maintenance activities. The maintenance management function may include managing:

- Fleets of maintenance, construction, or special service vehicles (e.g., snow and ice control equipment),
- Portable trailer-mounted devices (e.g., portable DMS and HAR) primarily used for construction and maintenance zone safety,
- Equipment along the roadside, including environmental sensors and automated systems that monitor and mitigate adverse road and surface weather conditions
- The tracking of maintenance activities of VDOT District infrastructure and equipment, including bridges, highways, traffic controllers, ITS devices, systems and communications, VDOT vehicles and other equipment associated with operating and maintaining the roadway infrastructure.

VDOT Districts will also track current construction activities and schedules, as well as remotely monitor and manage ITS applications in work zones. Encouraging safety within work zones is included in this function, and may involve managing traffic in the vicinity of the work zone and advising motorists of work zone status.

1.6 Regulatory Function

1.6.1 Traffic Law Enforcement Activities Support—includes establishing mechanisms, which will automatically detect vehicles operating in violation of Virginia traffic laws. VDOT District support may include the detection and identification of vehicles violating traffic laws that include:

- Intersection control,
- HOV lanes,
- Speed, and
- Work zone control.

1.6.2 Automated Emission Testing and Mitigation Support—includes collecting data regarding vehicle emissions to devise strategies, which will mitigate their effects. The roadside pollution assessment (RPA) capabilities shall detect moving vehicles, within its monitored area, whose emissions violate the emission standard. In addition to determining which suspected vehicles are not in compliance with emission standards, VDOT Districts may provide air quality statistical data to various agencies.

1.7 Public Transit Management

1.7.1 Support Schedule Reliability—includes supporting public transit operations by enabling some traffic control prioritization. When control and command detects a vehicle(s) has deviated from schedule it shall provide the capability to automatically determine the optimum scenario for returning the vehicle or fleet to schedule. Control and Command shall include an integrated traffic control capability that provides traffic signal preemption when required for schedule adjustment to Transit Vehicles at traffic signals.

1.7.2 Support for Public Transit Route Deviations and Other Public Transit Strategies Implementation—includes advising public transit operators on diversion route alternatives.

1.7.3 Support for Public Transit Security—includes establishing automated mechanisms to detect criminal activities and/or patron distress at park-and-ride facilities. Secure areas include:

- Bus stop areas,
- Parking lot areas,
- Transit vehicles,
- Kiosk areas, and
- Transit transfer locations.

Security Management and Control should include the capability to support coordinated multiple agency responses to incidents.

1.7.4 Advising Public of Status of Park-and-Ride—includes disseminating information on parking conditions at park-and-ride facilities to encourage the use of public transportation.

2 Electronic Payment Services

2.1 Electronic Payment Services

2.1.1 Electronic Payment Services Support—includes enabling electronic toll collection and integrating electronic payment mechanisms used in various modes of transportation and their respective facilities. VDOT District operations may include:

- Reading vehicle mounted tags or other sources of automated identification;
- Collecting and managing toll payments;
- Pricing structures for locally determined needs;
- Providing confirmation of transaction to each customer;
- Identifying those vehicles and/or operators that violate toll collection process;
- Accommodating single billing to commercial carriers; and

- Automatically accessing and processing each commercial vehicle's required documentation.

3 Emergency Management

3.2 Emergency Vehicle Management

1.2.6 Emergency Vehicle Management Support—includes providing route guidance and signal priority, as needed, to emergency vehicles responding to an incident. Route guidance involves maintaining real-time information on traffic conditions, incident locations, emergency response vehicle locations, and emergency response vehicle destinations to advise emergency response vehicles of appropriate routes.

3.3 Disaster Response and Evacuation

3.3.1 Emergency Notification System Support by Coordinating with Other Agencies—includes supporting the emergency notification function to provide adequate information to travelers. VDOT Districts may provide the capability to share information on received emergency calls and is responsible for clearing the scene of an emergency to avoid possible incidents.

APPENDIX D: FHWA FINAL RULE FOR CONCEPT OF OPERATIONS

Federal Requirements for Regional ITS Architecture	Needs Assessment	Strategic Plan	Regional Architecture	Business Plan
1. A description of the Region	Included			
2. Identification of participating agencies and other stakeholders			Included as part of stakeholder and element reports, as well as list of invited agencies in validation stages	
3. An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the Regional ITS Architecture	Identification of operational prevue relating to organizational mission	System implementation responsibilities/roles included	System operation responsibilities/roles included as part of the stakeholder-to-system element mapping	
4. Any agreements (existing or new) required for operations, including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the Regional ITS Architecture	New/future agreements will be identified	Existing agreements will be included		
5. System functional requirements		Included as mapping of VDOT-defined User Services		
6. Interface requirements and information exchanges with planned and existing systems and subsystems			Included in Interconnect and Architecture Flow diagrams	
7. Identification of ITS standards supporting Regional and national interoperability			Included as Turbo Output	
8. The sequence of projects required for implementation				Included